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University of Dayton Engineer Helps Cleveland Clinic Develop Powerful Motor for Implanted Heart Pump

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UNIVERSITY OF DAYTON ENGINEER HELPS CLEVELAND CLINIC DEVELOP POWERFUL MOTOR FOR IMPLANTED HEART PUMP

DAYTON, Ohio -- As the Tin Man in *The Wizard of Oz* would heartily attest, rust and artificial tickers are a dangerous mix. Corrosion poses a problem for designers of heart implant devices, too, if they hope to use metallic magnets to drive heart pump motors.

University of Dayton materials engineer Shiqiang Liu is working with The Cleveland Clinic Foundation to ensure that a promising heart pump being developed at the clinic remains corrosion-free when exposed to the levels of humidity and saline found in the human body. An assistant professor of materials engineering at UD, Liu is a research engineer in the University of Dayton Research Institute's Magnetics Laboratory.

Called a non-pulsatile heart pump, the device is small, light-weight and suitable for implant in children and adults. Four tiny but powerful magnets in the motor create an electrical current that spins an impeller, producing steady blood flow and pressure in the body. By eliminating a pulse, which the body does not need to stay alive, designers developed a pump that is simpler, smaller and less expensive than existing devices.

"UD is helping us optimize the electric motor that drives the system," said William Smith, an assistant professor of mechanical engineering at Ohio State University and a biomedical engineer at the Cleveland Clinic. Smith and Cleveland Clinic heart surgeon Leonard Golding began the heart pump project in the late 1980s and are fine-tuning the device before initiating clinical trials.

Known for its magnet testing capabilities, the magnetics laboratory at UD was a logical place for Cleveland Clinic researchers to turn for advice about magnets used in heart pump motors. The lab specializes in research and development of rare earth-transition metal magnetic materials.

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"The parts in the heart pump motor are very, very small," Liu said. "If the magnet corrodes, the oxides will fill the gaps between parts and that will kill the motor. It clogs up and then the motor shuts down."

In July, Liu began to review and select commercially available magnetic materials and coatings that can be used in the motor, testing them for strength and resistance to corrosion. He is concentrating on samarium-cobalt and neodymium-iron-boron materials, both rare-earth magnets that are roughly 100 times stronger than steel magnets.

"I am identifying the best candidates, exposing them to saline and humidity and analyzing them over time -- from a few hours to a few days to 1,000 hours -- to see how they change and to compare the different magnets," he said. Researchers at OSU's electrical engineering department will feed Liu's data into computer models for further analysis. The nine-month project is being funded by the Edison Biotechnology Center in Cleveland.

The magnets have no biological effect on the body, according to Smith. "The magnetic forces don't interact with the body," he said. "The magnets don't have contact with the body or blood."

By identifying a powerful, reliable and corrosion-resistant magnet, Liu will help Smith and Golding achieve their goal: to offer a heart-assist device that is light, affordable, reliable for two years or longer and applicable for most patients.

"Today's blood pumps fit the larger half of the population," Smith said. Smaller men, women and children have few options, he added.

The people most likely to benefit from the non-pulsatile heart pump are those suffering severe or end-stage damage in the heart's left ventricle, which helps supply oxygenated blood to all parts of the body. The non-pulsatile device could be implanted alongside the heart, assisting the diseased part of the organ.

"Our philosophy is to save the natural heart," Smith said, by providing a support device instead of a total transplant. "Doctors could leave the heart in and the pump could bypass or assist the sick side of the heart."

Golding said studies have shown about 35,000 people annually are in need of heart-assist devices, a figure that was cited in the journal *Artificial Organs* in 1985. *The Journal of the American Medical Association* also reported 10,000 patients a year need left ventricular assist pumps.

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Results from tests of non-pulsatile heart pumps implanted in calves have been good, Smith said, and non-pulsatile heart pumps that remain outside the body have been used successfully in people. He estimated clinical trials of implanted pumps could begin in three to five years.

The pump, which is made of titanium and plastic, weighs six ounces and measures 1.5 inches by 1.75 inches. The motor, the only moving part in the pump, spins at more than 3,000 revolutions per minute.

Research by Smith and Golding is being funded by The Cleveland Clinic Foundation and the Edison Biotechnology Center.

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For interviews, call **Shiqiang (Sam) Liu** at (513) 229-4496 or (513) 255-5928. To arrange interviews with **William Smith** and **Leonard Golding**, call **Elaine DeRosa** at the Cleveland Clinic Foundation at (216) 444-8927. For more information, contact **Candace Stuart** at (513) 229-3257.